WHAT IS CLAIMED IS:

1. A composition comprising:

an inorganic particle,

a linking group which has a distal end and a proximal end, the distal end being bound to an outer surface of the inorganic particle and the proximal end including a first charged or ionizable moiety, and

a macromolecule having a second charged or ionizable moiety, wherein the first and second charged or ionizable moieties electrostatically associate the inorganic particle with the macromolecule to form an ionic conjugate.

2. The composition of claim 1, wherein the inorganic particle is a semiconducting nanocrystal.

3. The composition of claim 2, wherein the semiconductor nanocrystal includes a first semiconductor material selected from the group consisting of a Group II-VI compound, a Group II-V compound, a Group III-VI compound, a Group III-V compound, a Group IV-VI compound, a Group I-III-VI compound, a Group II-IV-VI compound, and a Group II-IV-V compound.

4. The composition of claim 3, wherein the first semiconductor material is selected from the group consisting of ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgSe, HgTe, AlN, AlP, AlAs, AlSb, GaN, GaP, GaAs, GaSb, GaSe, InN, InP, InAs, InSb, TlN, TlP, TlAs, TlSb, PbS, PbSe, PbTe, and mixtures thereof.

5. The composition of claim 4, wherein the first semiconductor material is CdSe.

6. The composition of claim 5, wherein the first semiconductor material is overcoated with a second semiconductor material.

7. The composition of claim 6, wherein the second semiconductor material is ZnS, ZnO, ZnSe, ZnTe, CdS, CdO, CdSe, CdTe, MgS, MgSe, HgO, HgS, HgSe, HgTe, AlN,

AlP, AlAs, AlSb, GaN, GaP, GaAs, GaSb, GaSe, InN, InP, InAs, InSb, TlN, TlP, TlAs, TlSb, PbS, PbSe, PbTe, SiO_2, or mixtures thereof.

8. The composition of claim 1, wherein the inorganic particle further comprises a plurality of linking groups each independently including a third charged or ionizable moiety.

9. The composition of claim 8, further comprising a plurality of macromolecules, each of the macromolecules including a fourth charged or ionizable moiety, wherein the plurality of macromolecules are associated with the inorganic particle via electrostatic interaction with the plurality of inorganic particle linking groups.

10. The composition of claim 1, wherein the inorganic particle comprises Ag, Au, or a phosphor.

11. The composition of claim 1, wherein the first charged or ionizable group includes an hydroxide, alkoxide, carboxylate, sulfonate, phosphate, phosphonate, or quaternary ammonium.

12. The composition of claim 1, wherein the second charged or ionizable group includes an hydroxide, alkoxide, carboxylate, sulfonate, phosphate, phosphonate, or quaternary ammonium.

13. The composition of claim 1, wherein the linking group has the formula:

$$(R_1)_a\text{-}R_2\text{-}[(R_3)_b(R_4)_c]_d$$

wherein

R_1 is selected from the group consisting of C1-C100 heteroalkyl, C2-C100 heteroalkenyl, heteroalkynyl, -OR, -SH, -NHR, -NR'R", -N(O)HR, -N(O)R'R", -PHR, -PR'R", -P(NR'R")NR'R", -P(O)R'R", -P(O)(NR'R")NR'R", -P(O)(OR')OR", -P(O)OR, -P(O)NR'R", -P(S)(OR')OR", and -P(S)OR, wherein R, R', R" are independently selected from the group consisting of H, a branched or unbranched C1-C100 alkyl, a branched or unbranched C2-C100 alkenyl, a branched or unbranched C2-C100 alkynyl, a branched or unbranched C1-C100 heteroalkyl, a branched or unbranched C2-C100 heteroalkenyl, a

branched or unbranched C2-C100 heteroalkynyl, with the proviso that when a is greater than 1 the R_1 groups can be attached to the R_2 or R_3 groups at the same or different atoms within those groups, the R_1 groups can be the same or different, or the R_1 groups can form a six, seven, eight, nine, or ten membered cycloalkyl, cycloalkenyl, thereocyclic, aryl, heteroaryl, or a six- to thirty-membered crown ether or heterocrown ether;

R_2 is selected from a bond, a branched or unbranched C2-C100 alkylene, a branched or unbranched C2-C100 alkenylene, a branched or unbranched C2-C100 heteroalkenylene, cycloalkyl, cycloalkenyl, cycloalkynyl, heterocyclic, aryl, and heteroaryl;

R_3 is selected from a branched or unbranched C2-C100 alkylene, a branched or unbranched C2-C100 alkenylene, a branched or unbranched C2-C100 heteroalkenylene, cycloalkyl, cycloalkenyl, cycloalkynyl, heterocyclic, aryl, and heteroaryl;

R_4 is selected from the group consisting of hydrogen, a carboxylate, a thiocarboxylate, an amide, a hydrazine, a sulfonate, a sulfoxide, a sulfone, a sulfite, a phosphate, a phosphonate, a phosphonium ion, an alcohol, a thiol, an amine, an ammonium, an alkyl ammonium, a nitrate; and

a is 1 to 40, b is 0 to 3, c is 1 to 30, d is 1 to 3, and when d is 2 or 3 the R_3 groups can be the same or different or can be linked together to form a five to ten members cycloalkyl, cycloalkenyl, heterocyclic, aryl, or heteroaryl.

14. The composition of claim 1, wherein the linking group has the formula $HS\text{-}C_2H_4\text{-}CH(SH)\text{-}(C_4H_8)\text{-}COOH$.

15. The composition of claim 1, wherein the macromolecule includes a polypeptide or polynucleotide.

16. The composition of claim 15, wherein the macromolecule includes a polypeptide.

17. The composition of claim 16, wherein the second charged or ionizable moiety is a leucine zipper.

18. The composition of claim 16, wherein the second charged or ionizable moiety is polyaspartate.

19. The composition of claim 16, wherein the polypeptide includes a maltose binding protein.

20. The composition of claim 16, wherein the polypeptide includes an immunoglobulin G binding protein.

21. A composition comprising:

an inorganic particle,

a linking group which has a distal end and a proximal end, the distal end being bound to an outer surface of the inorganic particle and the proximal end including a first charged or ionizable moiety, and

a fusion protein including a second charged or ionizable moiety, wherein the first and second charged or ionizable moieties electrostatically associate the inorganic particle with the fusion protein to form an ionic conjugate.

22. The composition of claim 21, wherein the inorganic particle is a semiconducting nanocrystal.

23. The composition of claim 22, wherein the semiconductor nanocrystal includes a first semiconductor material selected from the group consisting of a Group II-VI compound, a Group II-V compound, a Group III-VI compound, a Group III-V compound, a Group IV-VI compound, a Group I-III-VI compound, a Group II-IV-VI compound, and a Group II-IV-V compound.

24. The composition of claim 21, wherein the inorganic particle further comprises a plurality of linking groups each independently including a third charged or ionizable moiety.

25. The composition of claim 24 further comprising a plurality of macromolecules, each of the macromolecules including a fourth charged or ionizable moiety, wherein the plurality of macromolecules are associated with the inorganic particle via electrostatic interaction with the plurality of inorganic particle linking groups.

26. The composition of claim 21, wherein the inorganic particle comprises Ag, Au, or a phosphor.

27. The composition of claim 21, wherein the first charged or ionizable group includes an hydroxide, alkoxide, carboxylate, sulfonate, phosphate, phosphonate, or quaternary ammonium.

28. The composition of claim 21, wherein the second charged or ionizable group includes an hydroxide, alkoxide, carboxylate, sulfonate, phosphate, phosphonate, or quaternary ammonium.

29. The composition of claim 21, wherein the linking group has the formula:

$$(R_1)_a\text{-}R_2\text{-}[(R_3)_b(R_4)_c]_d$$

wherein

R_1 is selected from the group consisting of C1-C100 heteroalkyl, C2-C100 heteroalkenyl, heteroalkynyl, -OR, -SH, -NHR, -NR'R", -N(O)HR, -N(O)R'R", -PHR, -PR'R", -P(NR'R")NR'R", -P(O)R'R", -P(O)(NR'R")NR'R", -P(O)(OR')OR", -P(O)OR, -P(O)NR'R", -P(S)(OR')OR", and -P(S)OR, wherein R, R', R" are independently selected from the group consisting of H, a branched or unbranched C1-C100 alkyl, a branched or unbranched C2-C100 alkenyl, a branched or unbranched C2-C100 alkynyl, a branched or unbranched C1-C100 heteroalkyl, a branched or unbranched C2-C100 heteroalkenyl, a branched or unbranched C2-C100 heteroalkynyl, with the proviso that when a is greater than 1 the R_1 groups can be attached to the R_2 or R_3 groups at the same or different atoms within those groups, the R_1 groups can be the same or different, or the R_1 groups can form a six, seven, eight, nine, or ten membered cycloalkyl, cycloalkenyl, thereocyclic, aryl, heteroaryl, or a six- to thirty-membered crown ether or heterocrown ether;

R_2 is selected from a bond, a branched or unbranched C2-C100 alkylene, a branched or unbranched C2-C100 alkenylene, a branched or unbranched C2-C100 heteroalkenylene, cycloalkyl, cycloalkenyl, cycloalkynyl, heterocyclic, aryl, and heteroaryl;

R_3 is selected from a branched or unbranched C2-C100 alkylene, a branched or unbranched C2-C100 alkenylene, a branched or unbranched C2-C100 heteroalkenylene, cycloalkyl, cycloalkenyl, cycloalkynyl, heterocyclic, aryl, and heteroaryl;

R_4 is selected from the group consisting of hydrogen, a carboxylate, a thiocarboxylate, an amide, a hydrazine, a sulfonate, a sulfoxide, a sulfone, a sulfite, a phosphate, a phosphonate, a phosphonium ion, an alcohol, a thiol, an amine, an ammonium, an alkyl ammonium, a nitrate; and

a is 1 to 40, b is 0 to 3, c is 1 to 30, d is 1 to 3, and when d is 2 or 3 the R_3 groups can be the same or different or can be linked together to form a five to ten members cycloalkyl, cycloalkenyl, heterocyclic, aryl, or heteroaryl.

30. The composition of claim 21, wherein the linking group has the formula $HS\text{-}C_2H_4\text{-}CH(SH)\text{-}(C_4H_8)\text{-}COOH$.

31. The composition of claim 21, wherein the second charged or ionizable moiety is a leucine zipper.

32. The composition of claim 21, wherein the second charged or ionizable moiety is polyaspartate.

33. The composition of claim 21, wherein the fusion protein includes a maltose binding protein.

34. The composition of claim 21, wherein the fusion protein includes an immunoglobulin G binding protein.

35. A method of forming an ionic conjugate, comprising:

providing an inorganic particle including a linking group having a distal end and a proximal end, the distal end being bound to an outer surface of the inorganic particle and the proximal end including a first charged or ionizable moiety; and

contacting a macromolecule having a second charged or ionizable moiety with the inorganic particle, wherein the first and second charged or ionizable moieties electrostatically associate the inorganic particle with the macromolecule to form an ionic conjugate.

36. The method of claim 35, wherein the inorganic particle is a semiconducting nanocrystal.

37. The method of claim 36, wherein the semiconductor nanocrystal includes a first semiconductor material selected from the group consisting of a Group II-VI compound, a Group II-V compound, a Group III-VI compound, a Group III-V compound, a Group IV-VI compound, a Group I-III-VI compound, a Group II-IV-VI compound, and a Group II-IV-V compound.

38. The method of claim 37, wherein the first semiconductor material is selected from the group consisting of ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgSe, HgTe, AlN, AlP, AlAs, AlSb, GaN, GaP, GaAs, GaSb, GaSe, InN, InP, InAs, InSb, TlN, TlP, TlAs, TlSb, PbS, PbSe, PbTe, and mixtures thereof.

39. The method of claim 38, wherein the first semiconductor material is CdSe.

40. The method of claim 39, wherein the first semiconductor material is overcoated with a second semiconductor material.

41. The method of claim 40, wherein the second semiconductor material is ZnS, ZnO, ZnSe, ZnTe, CdS, CdO, CdSe, CdTe, MgS, MgSe, HgO, HgS, HgSe, HgTe, AlN, AlP, AlAs, AlSb, GaN, GaP, GaAs, GaSb, GaSe, InN, InP, InAs, InSb, TlN, TlP, TlAs, TlSb, PbS, PbSe, PbTe, SiO_2, or mixtures thereof.

42. The method of claim 35, wherein the inorganic particle further comprises a plurality of linking groups each independently including a third charged or ionizable moiety.

43. The method of claim 35 further comprising a plurality of macromolecules, each of the macromolecules including a fourth charged or ionizable moiety, wherein the plurality of macromolecules are associated with the inorganic particle via electrostatic interaction with the plurality of inorganic particle linking groups.

44. The method of claim 35, wherein the inorganic particle comprises Ag, Au, or a phosphor.

45. The method of claim 35, wherein the first charged or ionizable group includes a hydroxide, alkoxide, carboxylate, sulfonate, phosphate, phosphonate, or quaternary ammonium.

46. The method of claim 35, wherein the second charged or ionizable group includes an hydroxide, alkoxide, carboxylate, sulfonate, phosphate, phosphonate, or quaternary ammonium.

47. The method of claim 35, wherein the linking group has the formula:

$$(R_1)_a\text{-}R_2\text{-}[(R_3)_b(R_4)_c]_d$$

wherein

R_1 is selected from the group consisting of C1-C100 heteroalkyl, C2-C100 heteroalkenyl, heteroalkynyl, -OR, -SH, -NHR, -NR'R", -N(O)HR, -N(O)R'R", -PHR, -PR'R", -P(NR'R")NR'R", P(O)R'R", P(O)(NR'R")NR'R", -P(O)(OR')OR", P(O)OR, P(O)NR'R", -P(S)(OR')OR", and P(S)OR, wherein R, R', R" are independently selected from the group consisting of H, a branched or unbranched C1-C100 alkyl, a branched or unbranched C2-C100 alkenyl, a branched or unbranched C2-C100 alkynyl, a branched or unbranched C1-C100 heteroalkyl, a branched or unbranched C2-C100 heteroalkenyl, a branched or unbranched C2-C100 heteroalkynyl, with the proviso that when a is greater than 1 the R_1 groups can be attached to the R_2 or R_3 groups at the same or different atoms within

those groups, the R_1 groups can be the same or different, or the R_1 groups can form a six, seven, eight, nine, or ten membered cycloalkyl, cycloalkenyl, thereocyclic, aryl, heteroaryl, or a six- to thirty-membered crown ether or heterocrown ether;

R_2 is selected from a bond (i.e., R_2 is absent in which case R_1 attaches to R_3), a branched or unbranched C2-C100 alkylene, a branched or unbranched C2-C100 alkenylene, a branched or unbranched C2-C100 heteroalkenylene, cycloalkyl, cycloalkenyl, cycloalkynyl, heterocyclic, aryl, and heteroaryl;

R_3 is selected from a branched or unbranched C2-C100 alkylene, a branched or unbranched C2-C100 alkenylene, a branched or unbranched C2-C100 heteroalkenylene, cycloalkyl, cycloalkenyl, cycloalkynyl, heterocyclic, aryl, and heteroaryl;

R_4 is selected from the group consisting of hydrogen, a carboxylate, a thiocarboxylate, and amid, an amine, a hydrazine, a sulfonate, a sulfoxide, a sulfone, a sulfite, a phosphate, a phosphonate, a phosphonium ion, an alcohol, a thiol, an amine, an ammonium, an alkyl ammonium, a nitrate; and

a is 1 to 4, b is 0 to 3, c is 1 to 3, d is 1 to 3, and when d is 2 or 3 the R_3 groups can be the same or different or can be linked together to form a five to ten members cycloalkyl, cycloalkenyl, heterocyclic, aryl, or heteroaryl.

48. The method of claim 35, wherein the linking group has the formula $HS\text{-}C_2H_4\text{-}CH(SH)\text{-}(C_4H_8)\text{-}COOH$.

49. The method of claim 35, wherein the macromolecule includes a polypeptide or a polynucleotide.

50. The method of claim 49, wherein the macromolecule includes a polypeptide.

51. The method of claim 50, wherein the second charged or ionizable moiety is a leucine zipper.

52. The method of claim 50, wherein the second charged or ionizable moiety is polyaspartate.

53. The method of claim 50, wherein the polypeptide includes a maltose binding protein.

54. The method of claim 50, wherein the polypeptide includes an immunoglobulin G binding protein.

55. The method of claim 35 further including forming the macromolecule by recombinant methods.

56. The method of claim 35 further including forming the macromolecule by synthetic methods.

57. A method of detecting the presence of a predetermined species in a solution, comprising:

contacting a solution with an ionic conjugate, wherein the ionic conjugate includes an inorganic particle electrostatically associated with a macromolecule, the macromolecule capable of binding specifically to the predetermined species.

58. The method of claim 57 further comprising forming an ionic conjugate by adding an inorganic particle and a macromolecule to the solution, wherein the inorganic particle includes a linking group having a distal end and a proximal end, the distal end being bound to an outer surface of the inorganic particle and the proximal end including a first charged or ionizable moiety and the macromolecule includes a second charged or ionizable moiety, the first and second charged or ionizable moieties associating electrostatically to form the ionic conjugate.